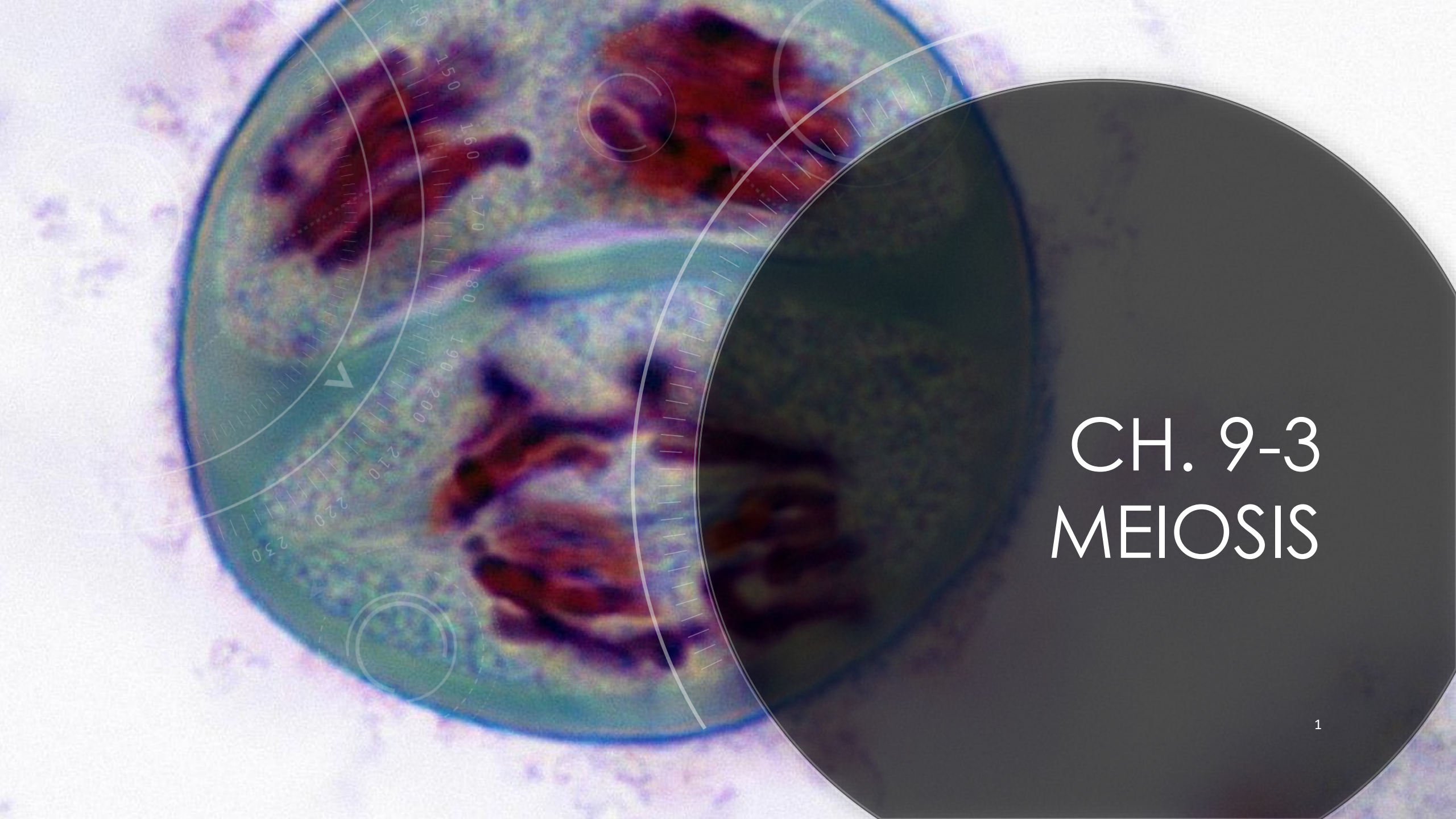
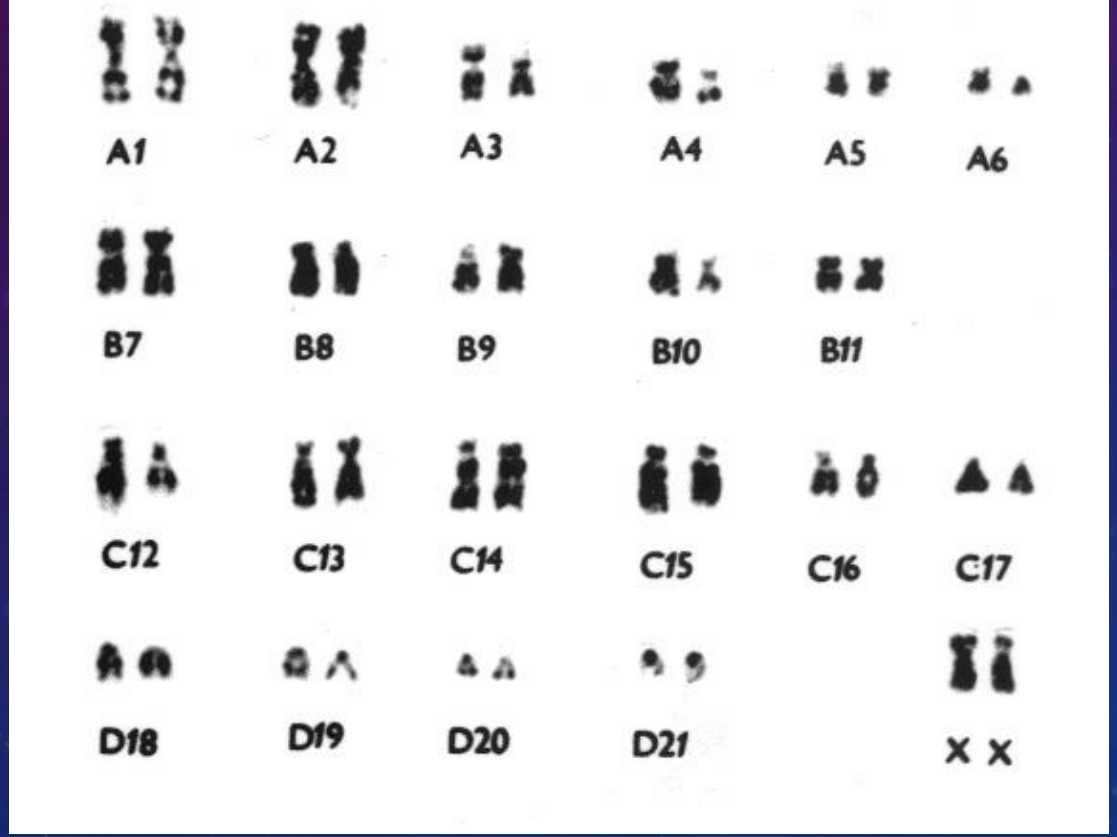


CH. 9-3 MEIOSIS

LEARNING OBJECTIVES

You should be able to:

- Determine haploid and diploid numbers.
- Define homologous chromosomes.
- Distinguish between autosomes/sex chromosomes.
- Identify and draw stages of meiosis. Determine ploidy and chromosome number for different stages of meiosis.
- Distinguish between somatic cells and gametes, and give examples.
- Describe the phenomena of independent assortment and crossing over, and explain their significance.
- Compare and contrast mitosis and meiosis.

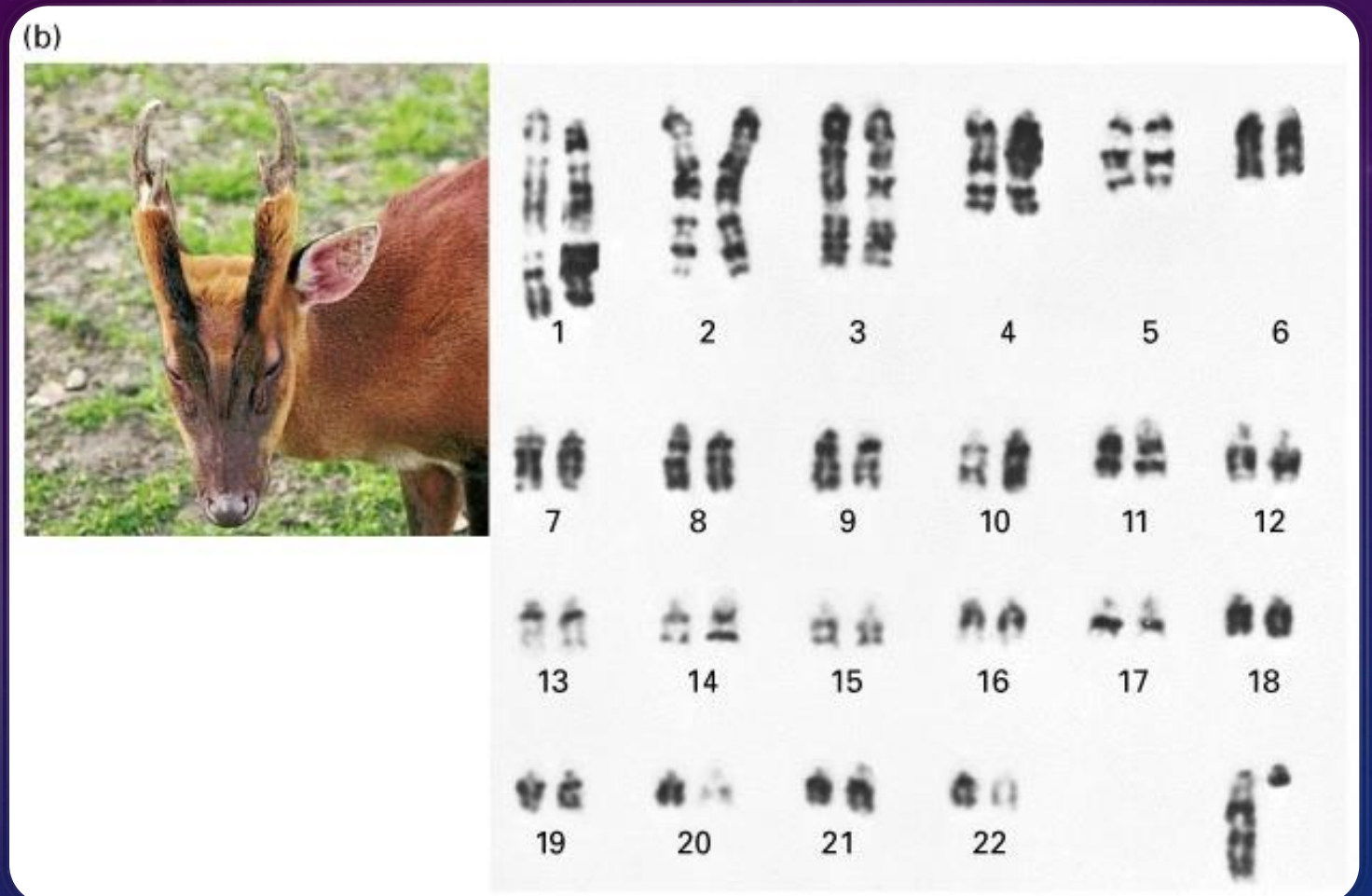


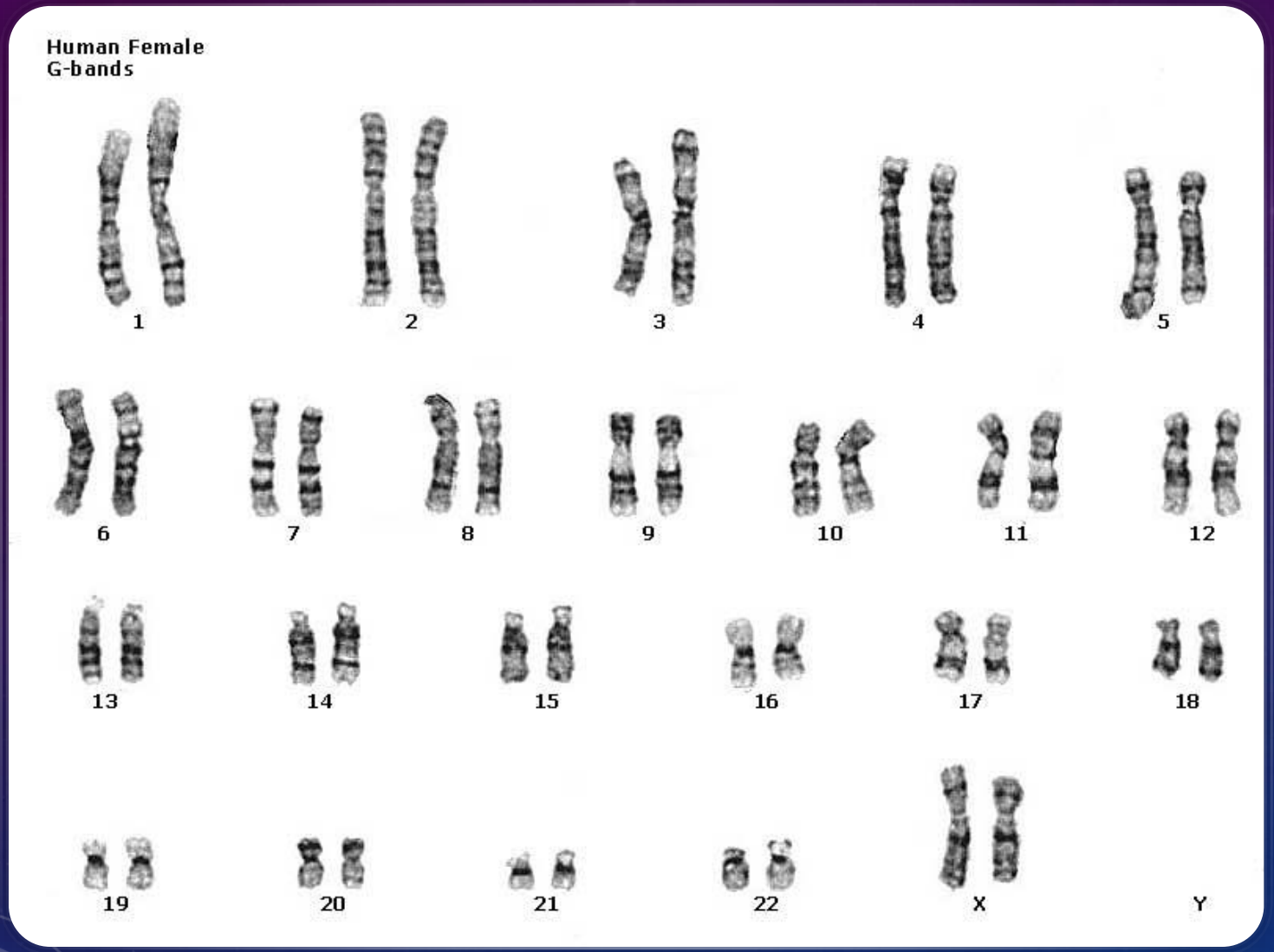
KARYOTYPE

- An organism's complete set of chromosomes

KARYOTYPE

- An organism's complete set of chromosomes



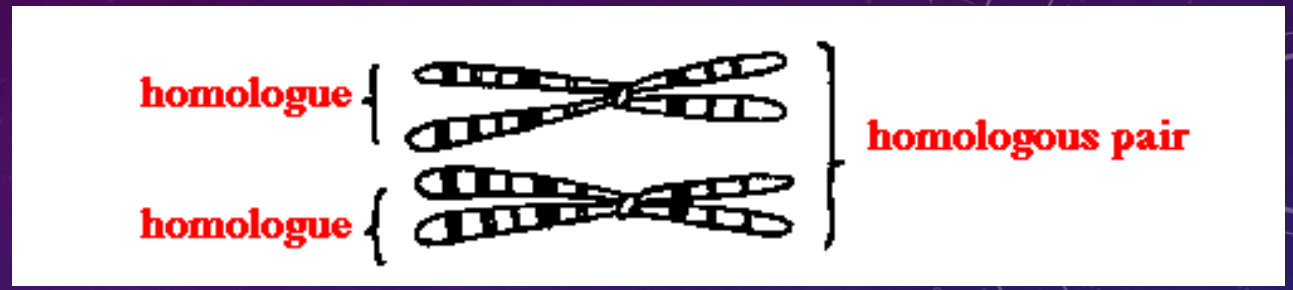


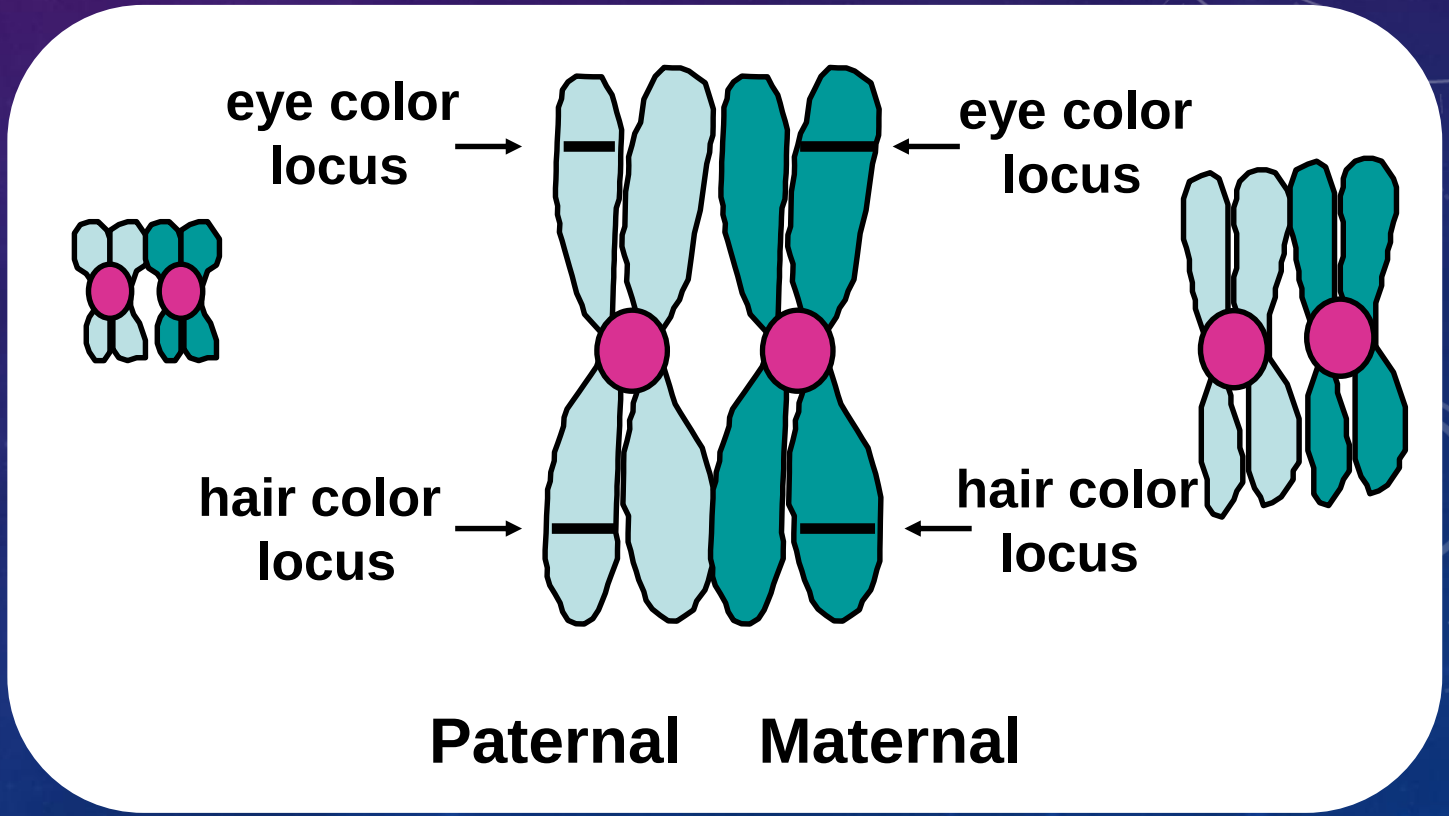
KARYOTYPE

- An organism's complete set of chromosomes

HOMOLOGOUS CHROMOSOMES

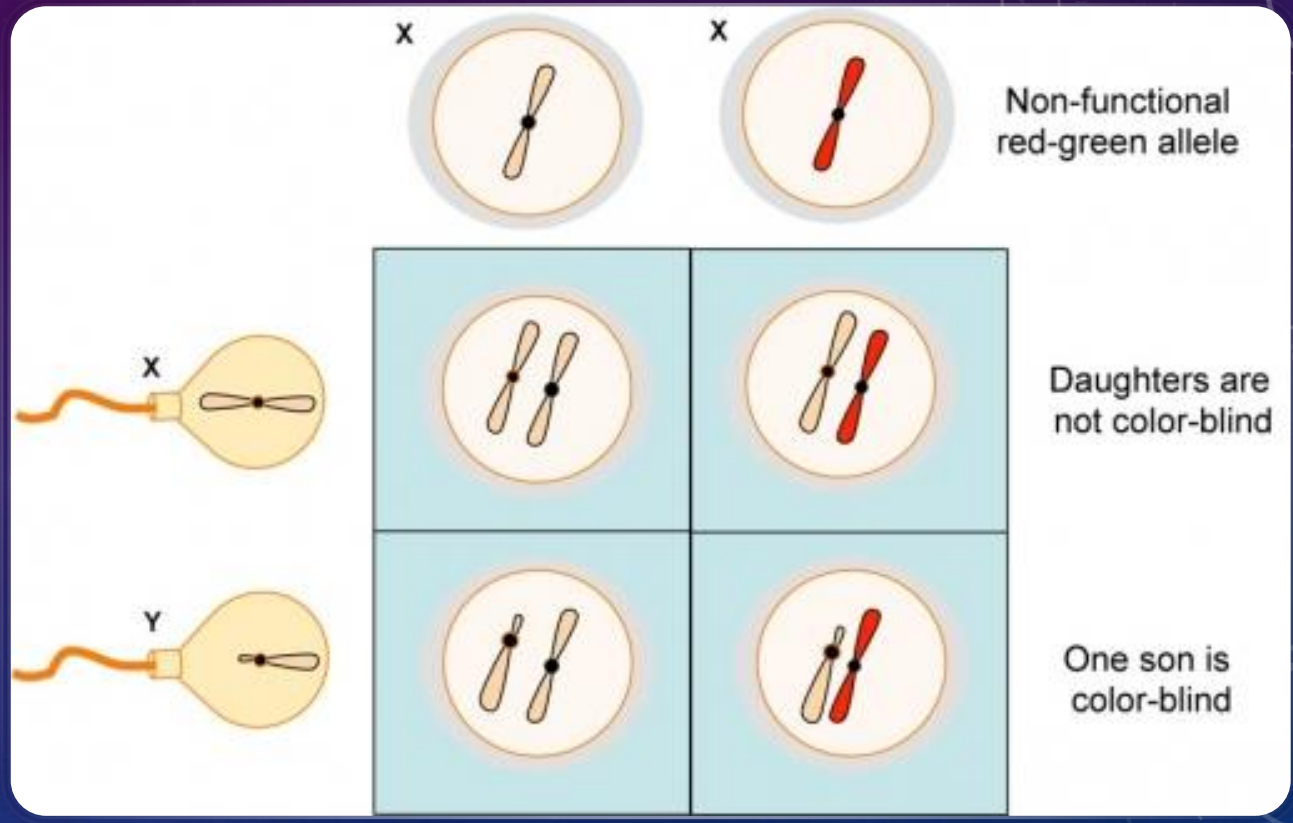
- Matching chromosomes called **homologous** pairs/homologous chromosomes
- Have the same genes, different alleles
  - Allele: version of a gene that codes for a trait





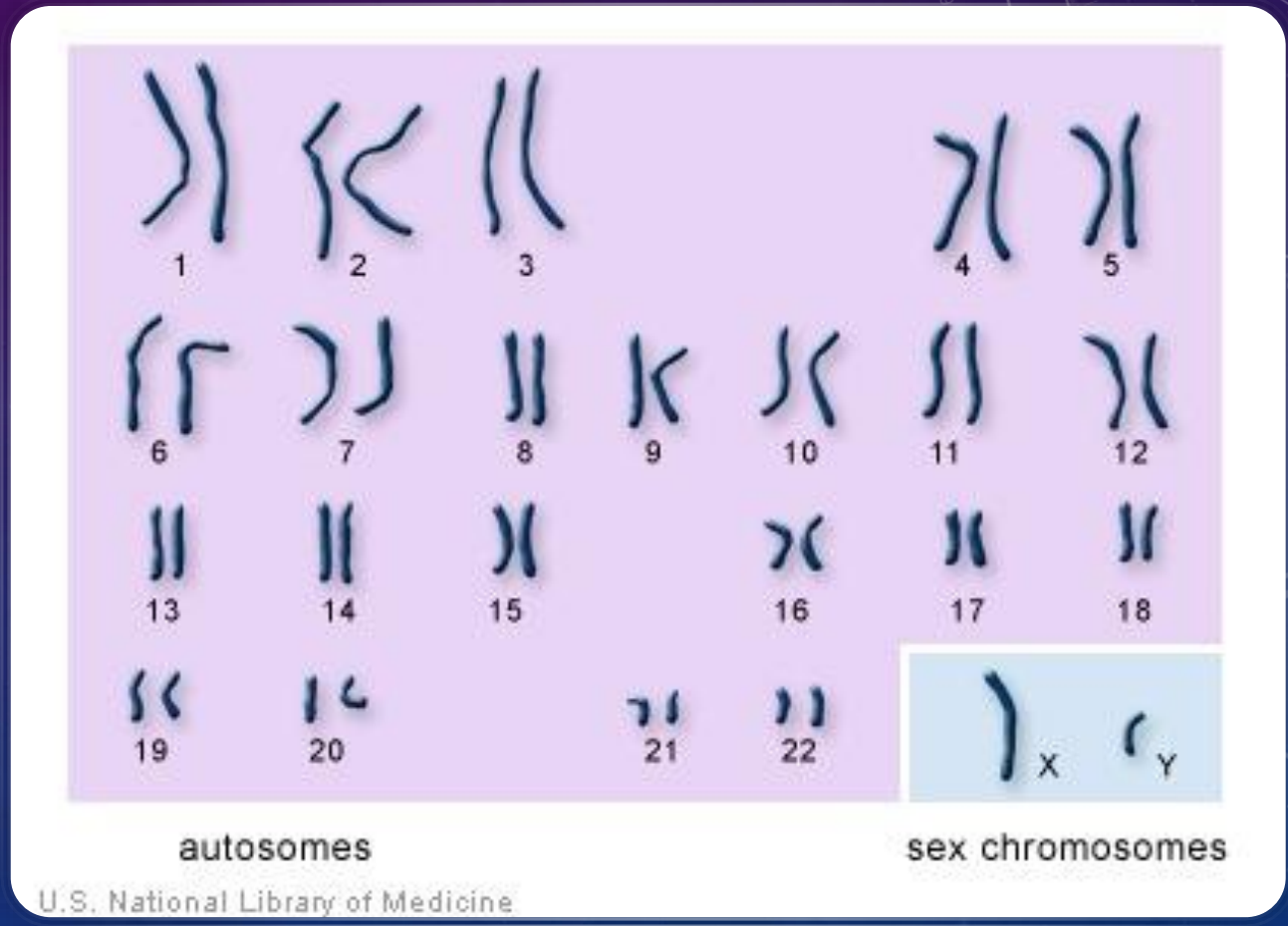
HOMOLOGOUS CHROMOSOMES

- One set inherited from each parent
- Genes interact to determine organism's traits



AUTOSOMES VS SEX CHROMOSOMES

- **Sex chromosome:**
  - Determines sex of the cell/organism
  - In humans:
    - X and Y chromosomes
    - XX: female
    - XY: male
- **Autosome:**
  - All other chromosomes



AUTOSOMES VS SEX CHROMOSOMES

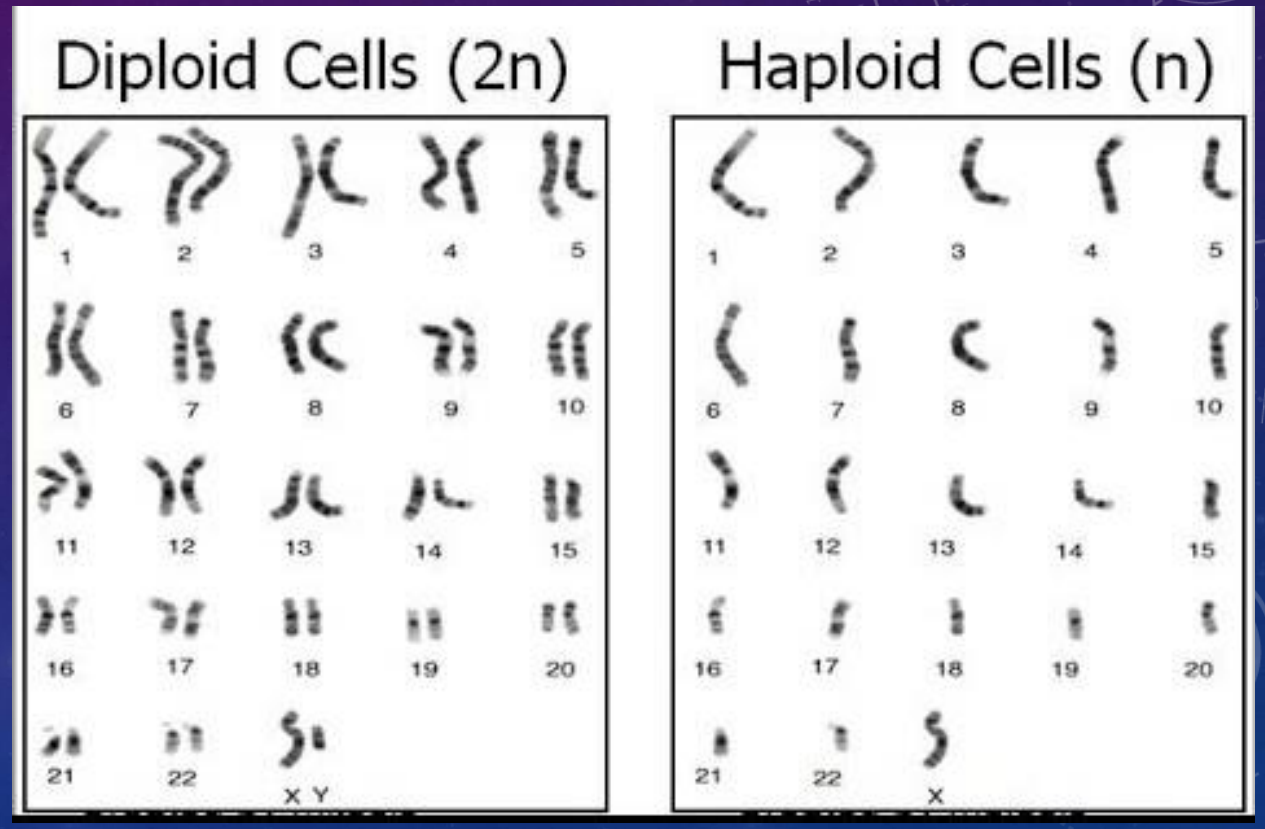
Sex Determination Chart

Not every animal has the same sex chromosomes.

Type	Example	Male	Female	Homogametic	Heterogametic
XY	Humans & Fruit Flies	XY	XX	Female	Male
2N/ N	Bees	N	NN	Male and Female	--
XO	Grasshopper	XO	XX	Female	Male
ZW	Birds	ZZ	ZW	Male	Female
ZO	Chickens	ZZ	ZO	Male	Female

PLOIDY

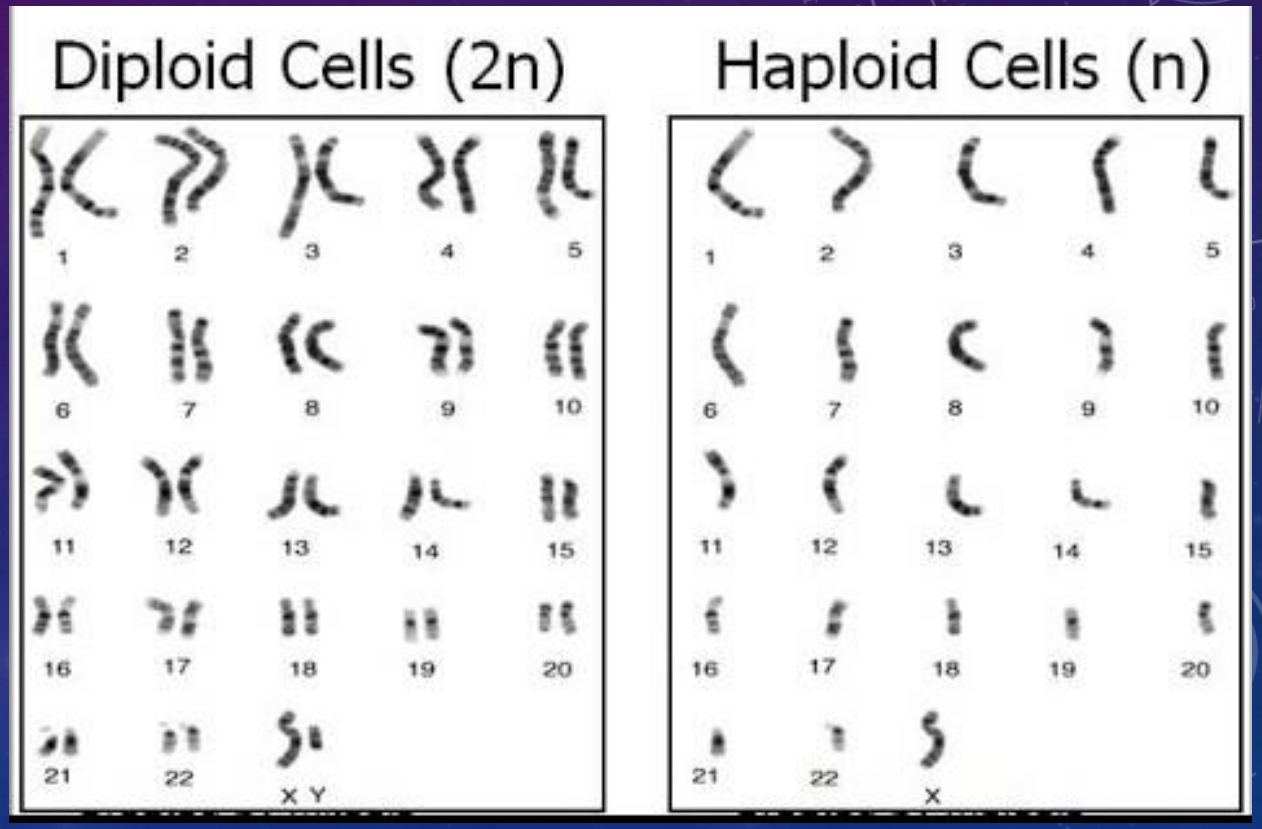
- **Haploid number**: the number of different chromosomes in one set, denoted by "*n*"
- **Ploidy**: number of complete chromosome sets in the somatic cells of an organism
  - **Haploid** (*1n*)
  - **Diploid** (*2n*)
  - (Also: triploid, tetraploid, etc)



PLOIDY EXAMPLES

Humans are diploid organisms:

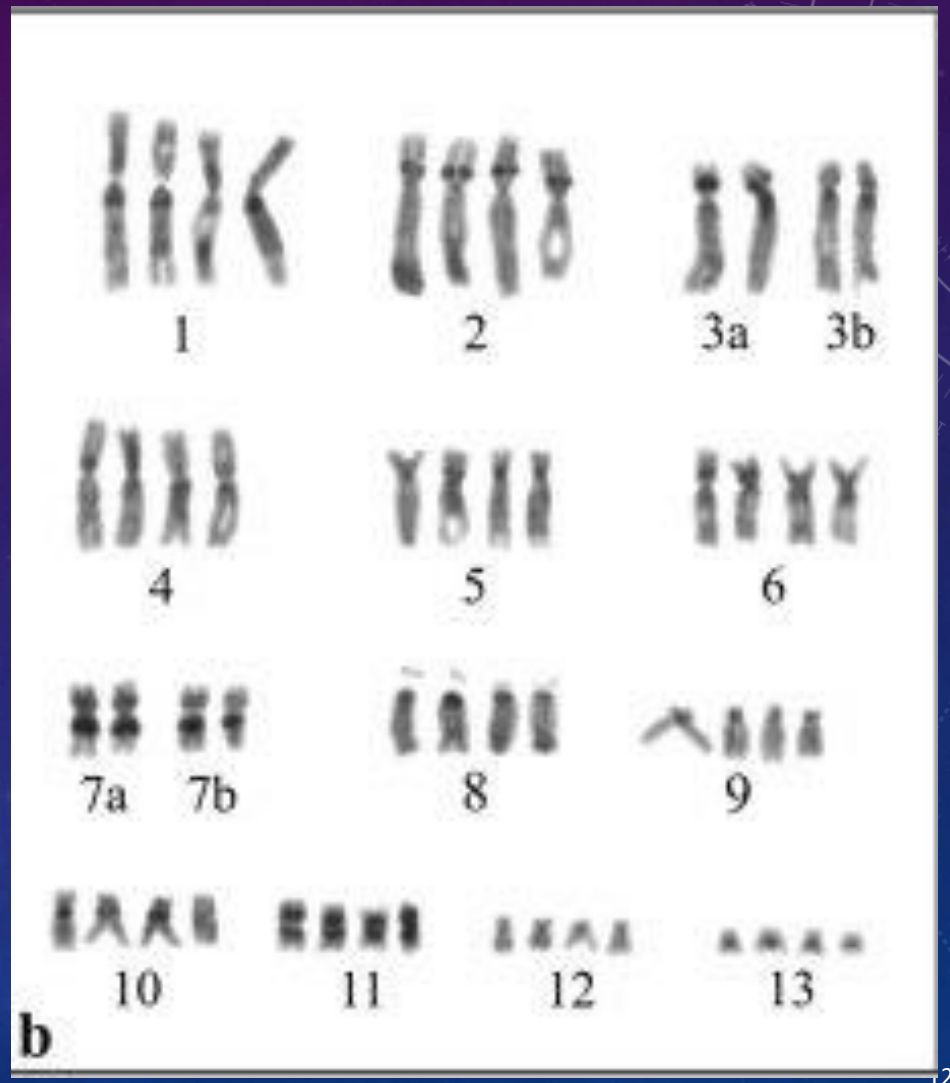
- Haploid number: n=23
- Diploid number: 2n=46



PLOIDY EXAMPLES

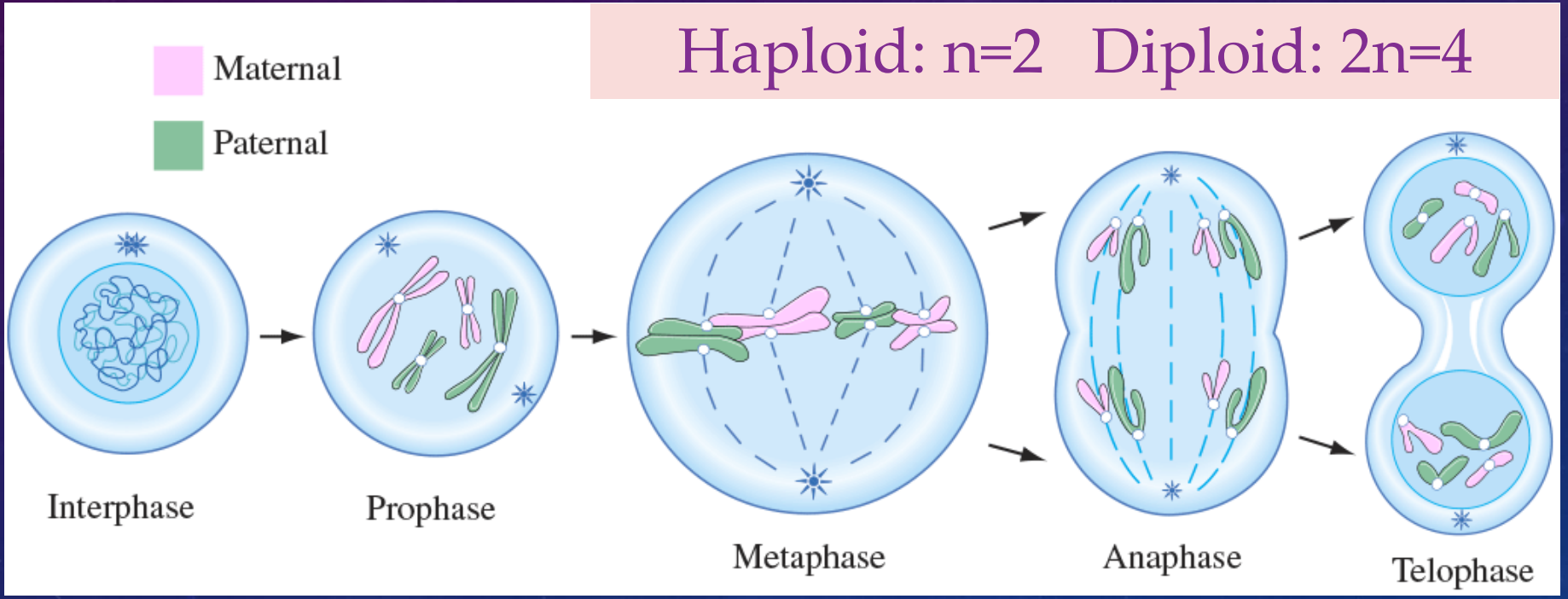
Phyllomedusa tetraploidea are tetraploid organisms:

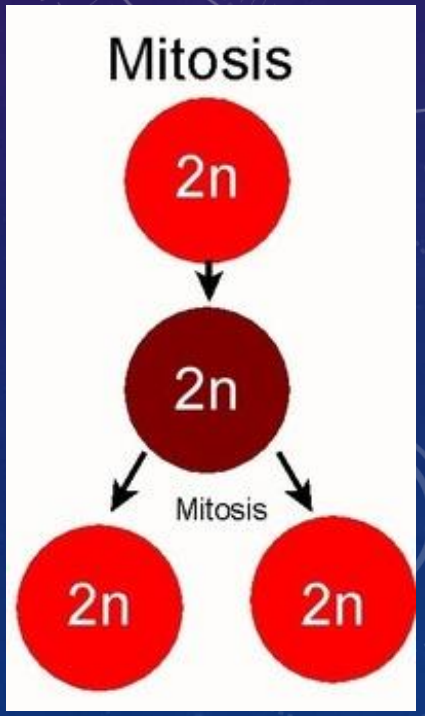
- Haploid number: n=13
- Tetraploid number: 4n=52



PLOIDY PRACTICE

What are the haploid and diploid numbers shown below?



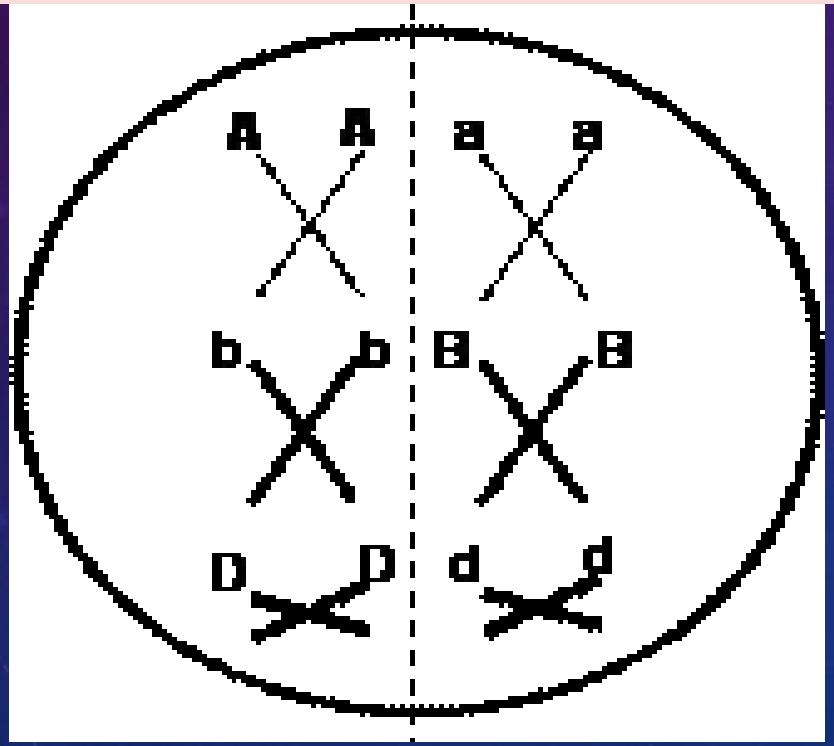


Ploidy and chromosome number do not change before/after mitosis.

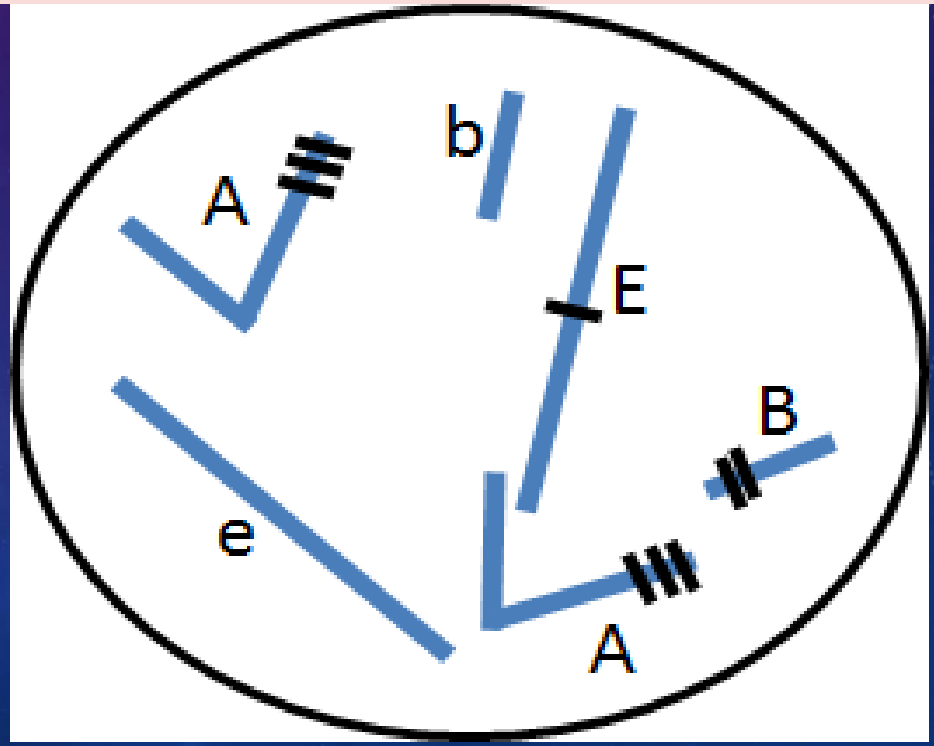
PLOIDY PRACTICE

What are the haploid and diploid numbers shown below?

Haploid: n=3 **Diploid: 2n=6**



Haploid: n=3 **Diploid: 2n=6**



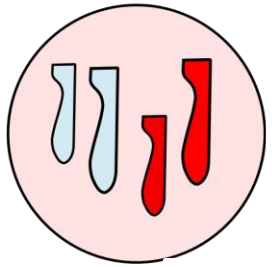
PLOIDY PRACTICE

1) Draw a diploid cell with 10 chromosomes (2n=10).
2) Draw a triploid cell with 9 chromosomes (3n=9).

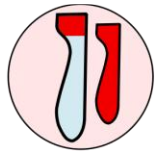
PLOIDY PRACTICE

What are the haploid and diploid numbers shown below?

Haploid # : n=2
Diploid: 2n=4



Haploid: n=2

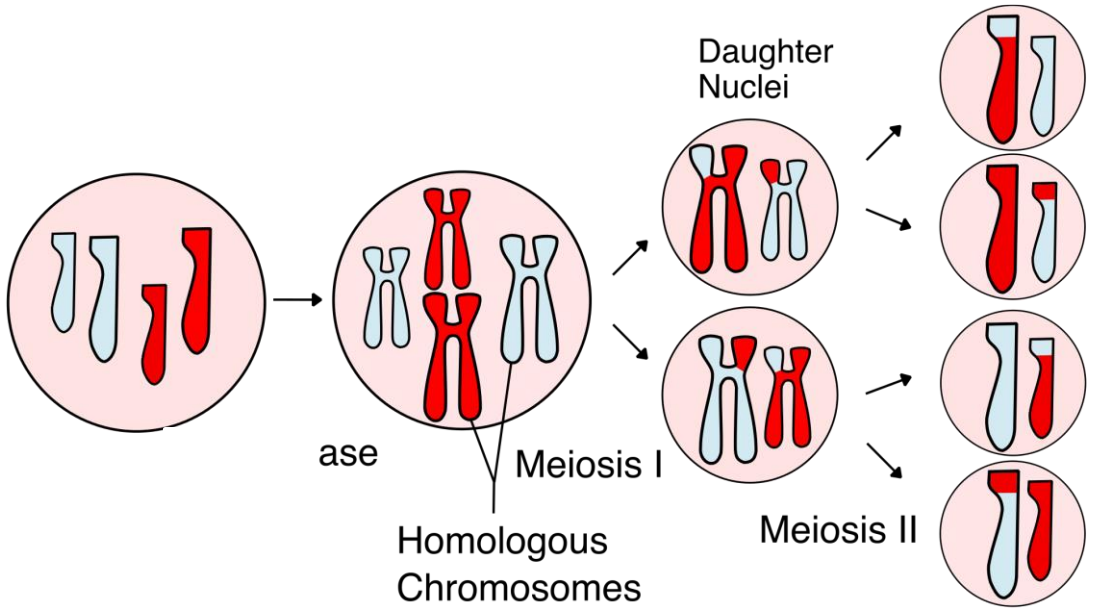


PLOIDY PRACTICE

What are the haploid and diploid numbers shown below?

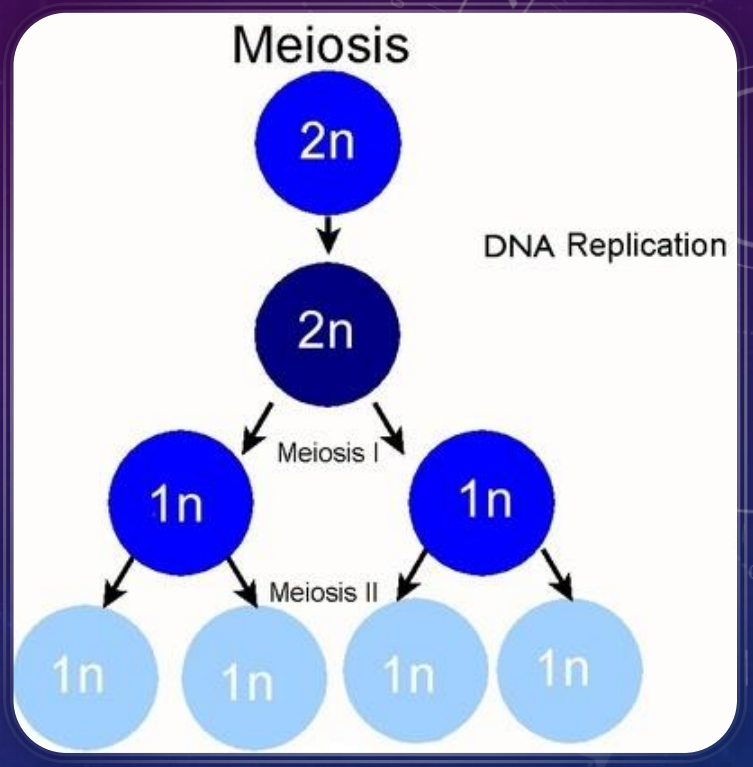
Diploid: 2n=4

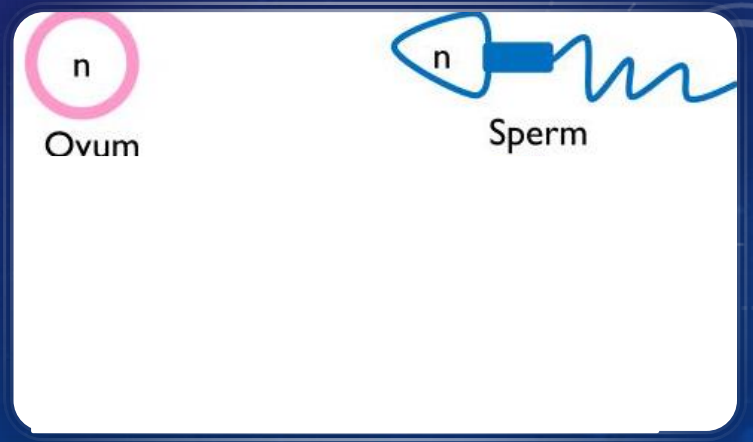
Haploid: n=2



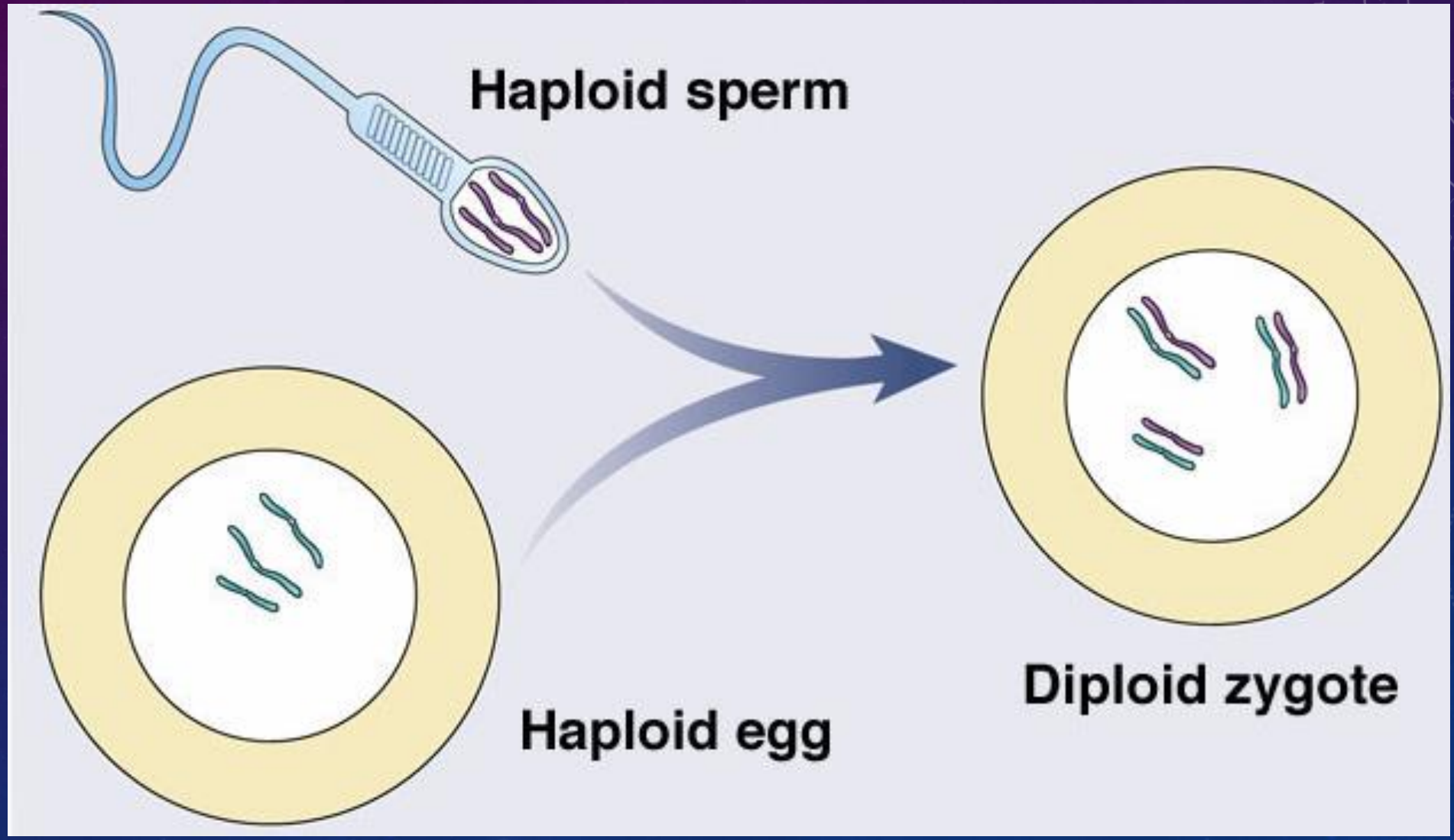
MEIOSIS: THE BIG PICTURE

- **Meiosis**: reduction division
  - Chromosomes reduced to half their original number (from diploid to haploid)
  - Produces haploid gametes (sex cells: sperm and egg)
  - During fertilization, haploid gametes fuse to produce a diploid zygote
  - Diploid zygote undergoes mitosis



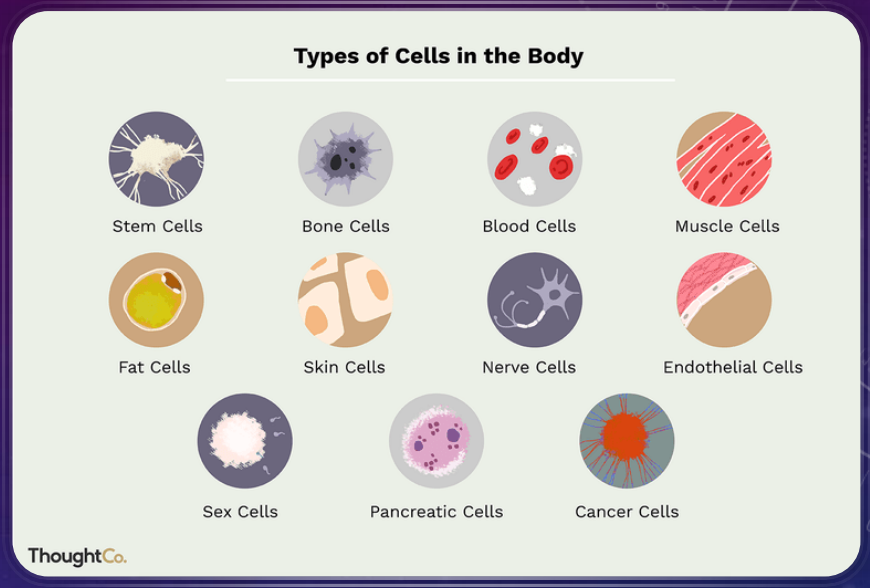


FERTILIZATION

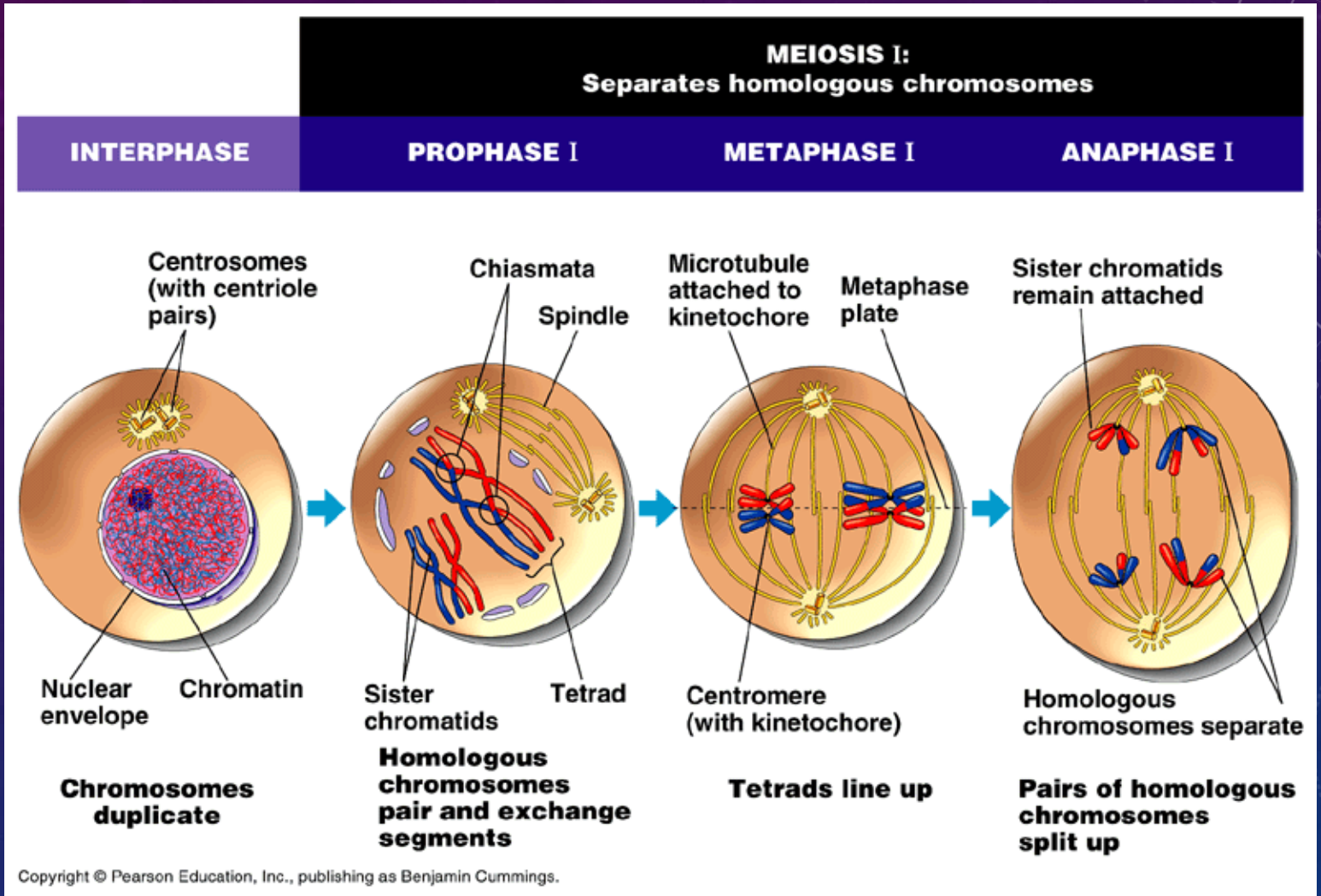


SOMATIC CELLS VS GAMETES

- **Somatic cells**: regular body cells
  - Skin, heart, liver, eye, etc
  - Diploid (2n) in humans
  - Produced by mitosis
- **Gametes**: sex cells
  - Sperm, egg (ovum)
  - Haploid (1n) in all sexually reproducing organisms
  - Produced by meiosis



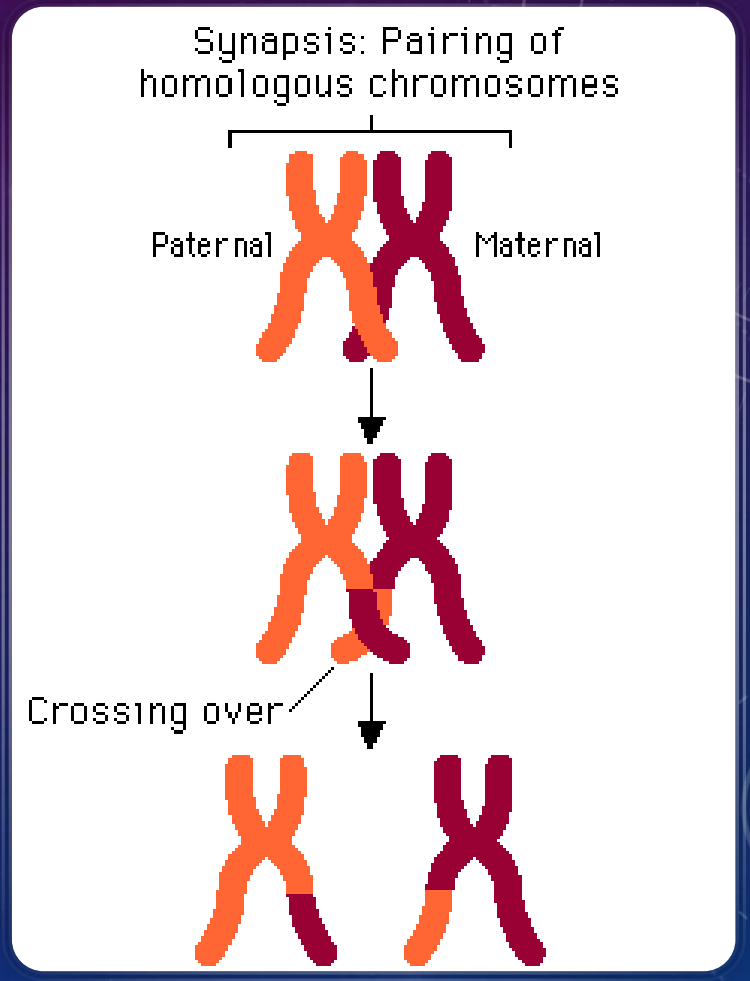
MEIOSIS I



MEIOSIS I

Prophase I:

- **Synapsis**: homologous pairs attach at centromeres
- **Crossing over**: homologous chromosomes exchange genes (genetic recombination)
  - Creates genetic variation



MEIOSIS I

Metaphase I:

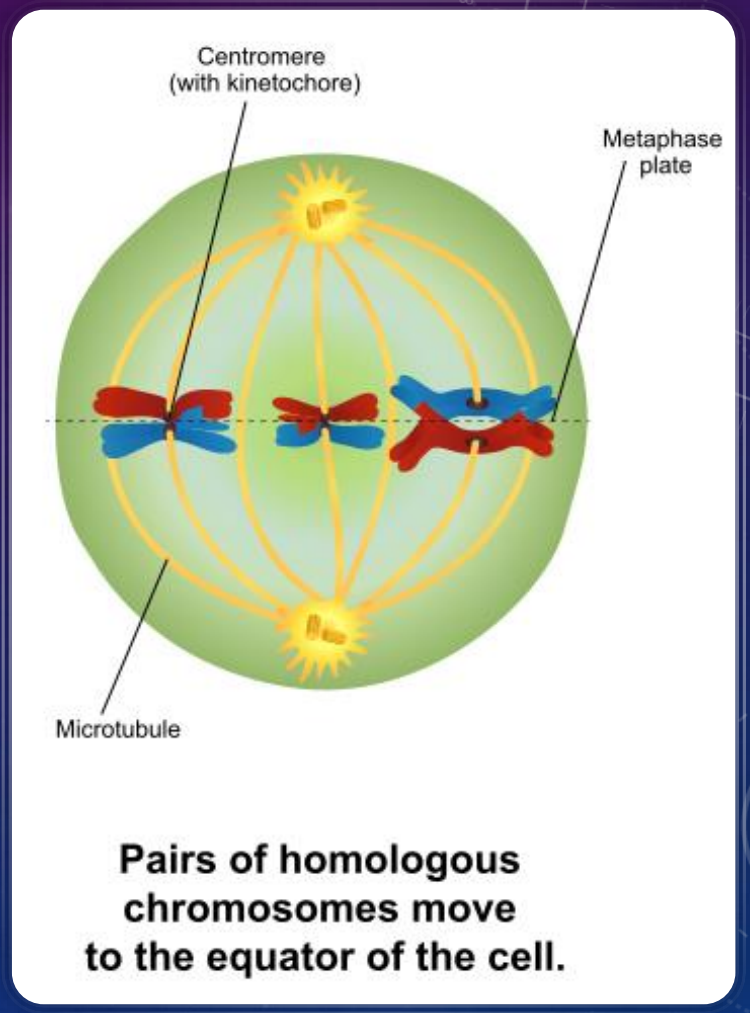
- Homologous pairs line up at middle

Anaphase I

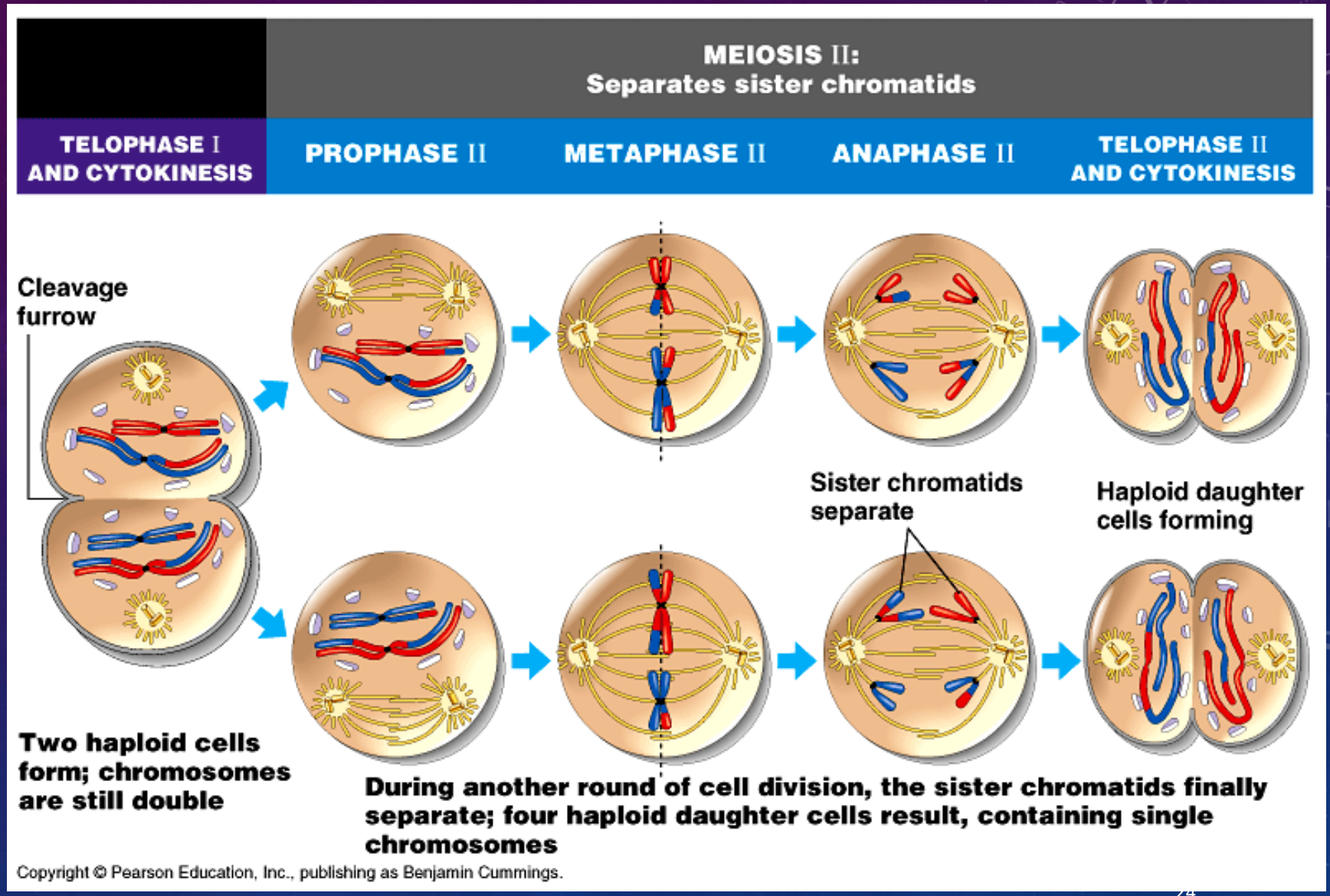
Telophase I

RESULT:

- Homologous pairs separated
- 2 haploid cells, each with 2 sister chromatids per chromosome



MEIOSIS II


MEIOSIS II:
Separates sister chromatids
TELOPHASE I AND CYTOKINESIS
PROPHASE II
METAPHASE II
ANAPHASE II
TELOPHASE II AND CYTOKINESIS
Cleavage furrow
Sister chromatids separate
Haploid daughter cells forming
Two haploid cells form; chromosomes are still double
During another round of cell division, the sister chromatids finally separate; four haploid daughter cells result, containing single chromosomes
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MEIOSIS II

All phases essentially identical to mitosis

- Prophase II, Metaphase II, Anaphase II, Telophase II

RESULT:

- Sister chromatids separated
- 4 haploid cells, each with 1 sister chromatid per chromosome

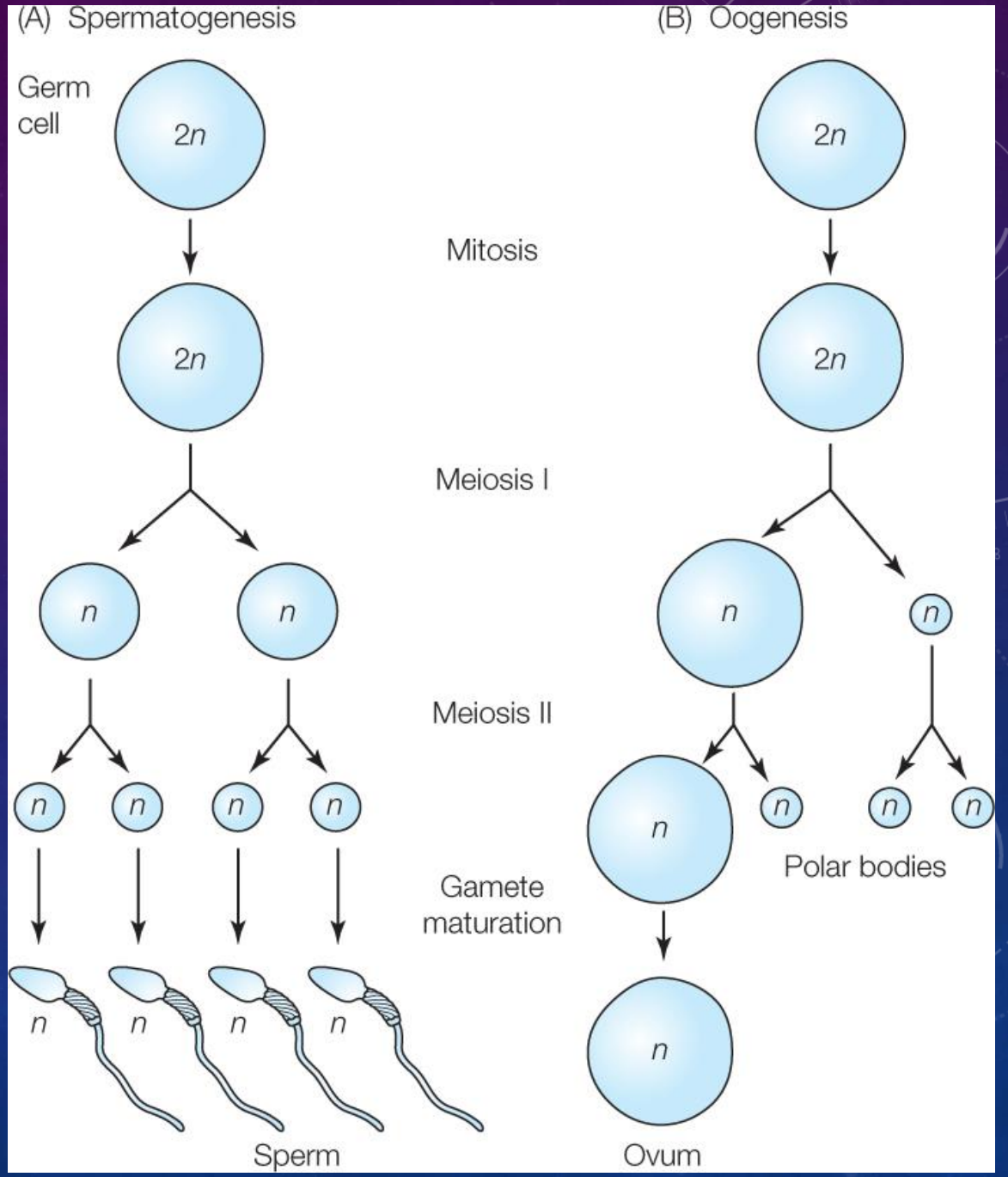
MEIOSIS II

Per meiotic division:

Males: 4 viable sperm

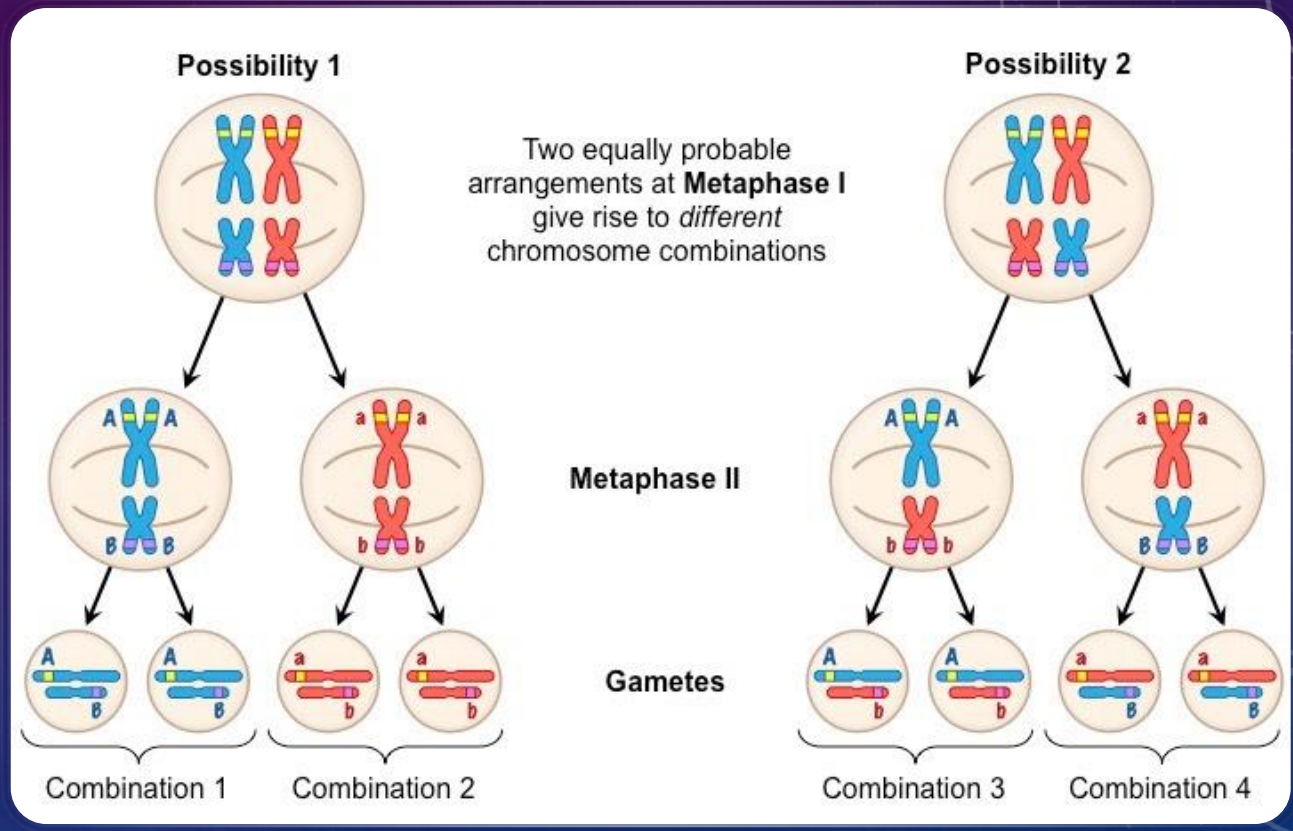
Females: 1 viable egg

- Meiosis uneven:
  - 1 egg (gets all resources)
  - 3 polar bodies (disintegrate)



INDEPENDENT ASSORTMENT

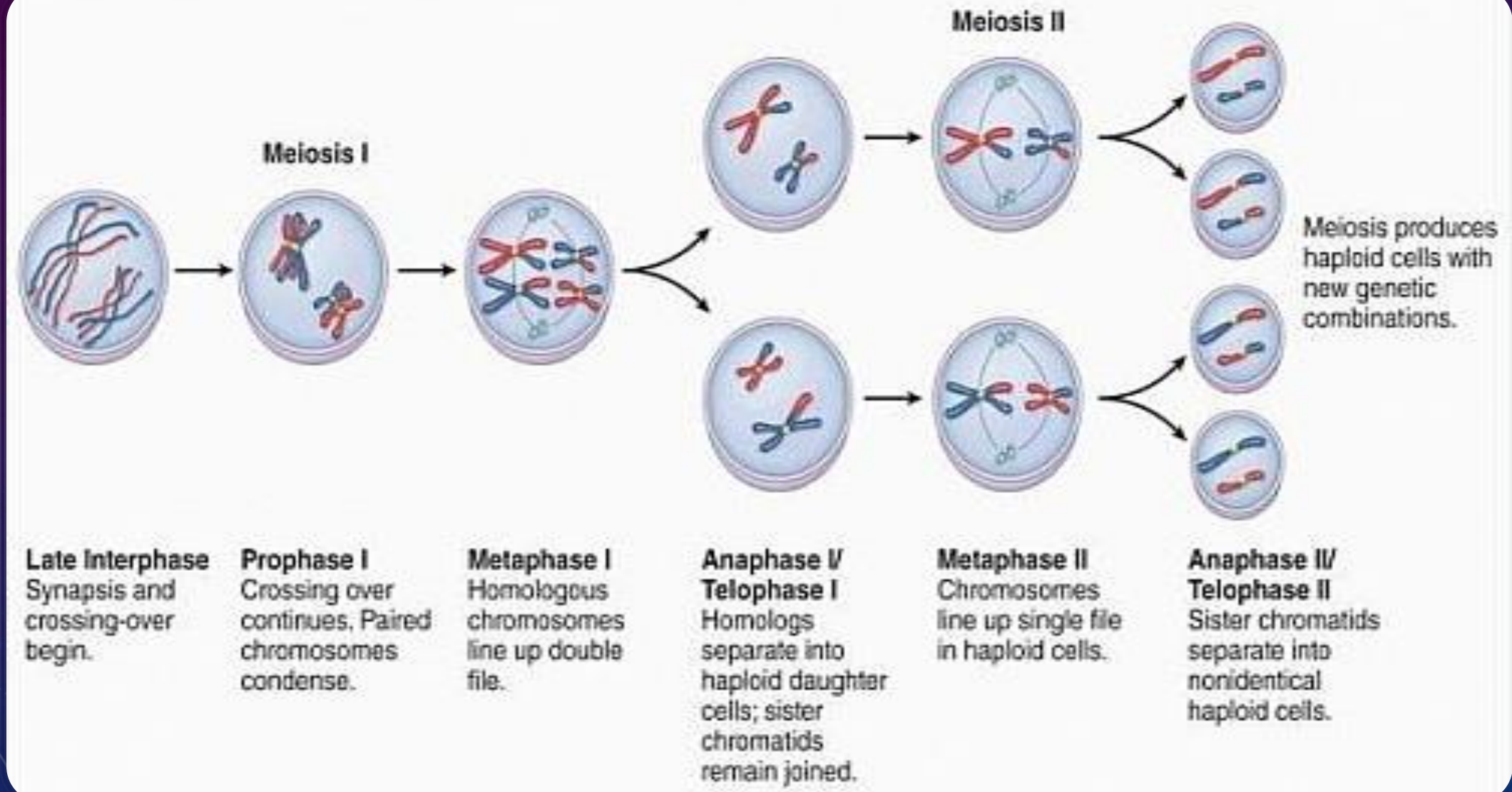
- In Metaphase I, homologous pairs are randomly oriented
- Chances of inheriting one gene is unrelated to chances of inheriting another! (i.e. they are independent)



http://ib.bioninja.com.au/higher-level/topic-10-genetics-and-evolu/101-meiosis/random-assortment.html

SUMMARY MEIOSIS

(MANY OTHERS AVAILABLE ONLINE)



VOCAB SUMMARY (MEIOSIS)

Testable

- Chromosome, Homologous, Gene, Autosome, Sex Chromosome, Ploidy, Haploid, Diploid, Fertilization, Somatic cell, Gamete (sperm, egg)
- Meiosis, Prophase/Metaphase/Anaphase/ Telophase I and II, Synapsis, Crossing over, Independent assortment

Not testable

- Karyotype, Allele
- Triploid, Tetraploid… (I would tell you if it was 3n, 4n, etc)

COMPARISON

Mitosis

- No synapsis or crossing over
- Centromere splits: 2 chromatids become 2 chromosomes
- 1 division → 2 cells
- 2n → 2n or n → n
- Somatic cells

Meiosis

- Synapsis, crossing over
- Homologous pairs separate in meiosis I: meiosis II involves centromere splitting
- 2 divisions → 4 cells
- 2n → n
- Gametes